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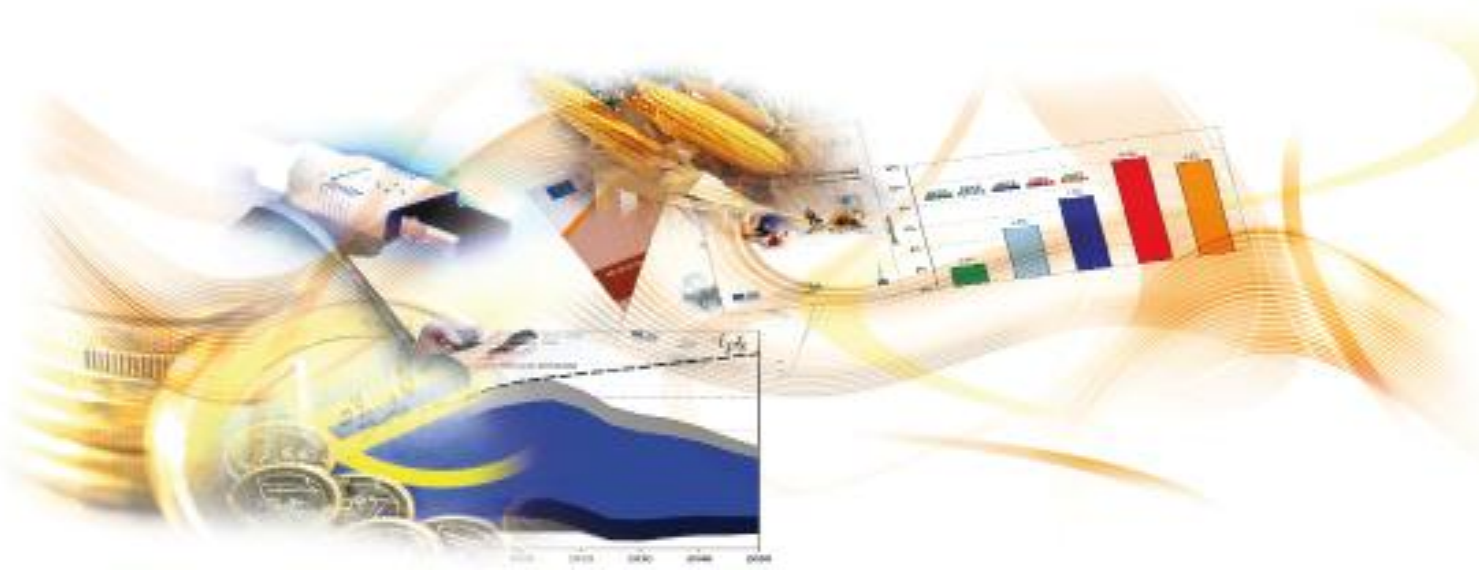

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The Country Report 2012 builds on and updates the 2011 edition. The report identifies the structural challenges of the national research and innovation system and assesses the match between the national priorities and the structural challenges, highlighting the latest developments, their dynamics and impact in the overall national context.

The first draft of this report was produced in December 2012 and was focused on developments taking place in the previous twelve months. In particular, it has benefited from comments and suggestions of Mathieu DOUSSINEAU from JRC-IPTS who reviewed the draft report. The contributions and comments from DG-RTD are also gratefully acknowledged.

The report is currently only published in electronic format and is available on the ERAWATCH website. Comments on this report are welcome and should be addressed to jrc-ipts-erawatch-helpdesk@ec.europa.eu.

EXECUTIVE SUMMARY

Along with the socio-economic transformation after 1990, the research and development (R&D) system underwent a substantial size reduction. In recent years, the Czech Republic is catching up with advanced European countries; however, the lag remains significant, especially in R&D outputs, such as top quality scientific publications and international patents. R&D expenditures along with the numbers of researchers, doctoral graduates and tertiary students have increased steadily over the last decade. Yet most of the relevant indicators have not reached the EU27 average.

In 2011, gross domestic expenditure on R&D (GERD) amounted to €2.9b with a slight predominance of private funding over the public one. Despite the current economic crisis and major slowdown of economic growth, R&D intensity of the economy in terms GERD as % of GDP noticeably increased in recent years from the bottom of 1.41% in 2008 to 1.84% in 2011; hence getting somewhat closer to the target of 2.7% outlined in the Europe 2020 initiative. A clear trend of the recent years is the growth of business and foreign R&D funding, while public resources earmarked to R&D tend to stagnate (Eurostat, 2013a).

The Czech Republic has a strong public research system based on a developed network of public universities and research institutes. However, a major weakness of the public research sector has traditionally been limited commercialization of the outputs. The R&D evaluation system did not motivate researchers to cooperate with the business sector. This problem has been addressed by the Reform of the research, development and innovation (RDI) System and National Research, Development and Innovation Policy 2009-2015. Unfortunately, the results have been disappointing so far.

Based on the latest economic trends, the national innovation performance as well as on national strategic documents dealing with RDI policy, and strengths and weaknesses of the system, the following main structural challenges and relevant policy measures were identified:

- *Inefficient use of public funds for supporting R&D and innovation.* To tackle this problem, it is necessary to introduce of a complex methodology for evaluation of R&D results; the current one based predominantly on quantitative indicators has been identified as unsatisfactory; the necessity to update the evaluation methodology has been emphasized in the International Audit of Czech R&D; however, the revision requires consensus of the key players in the national R&D system, which proved extremely difficult to achieve, especially if redistribution of public funds between sectors is at stake.

- *Lack of external financial resources for innovation.* The Technology Agency of the Czech Republic (TA CR) has been established in 2009 as the dominant supporter of applied research and launched a portfolio of new programmes; two programmes of the OP EI, Progress and Guarantee, help start-ups and micro enterprises to overcome the limited availability of external funding; however, availability of venture capital remains one of the lowest among EU27 countries; the Ministry of Industry and Trade (MIT) announced plans to establish a public seed fund financed from the OP EI to boost the access to venture capital.

- *Lack of public-private collaboration.* The Operational Programme Research and Development for Innovation (OP RDI) supports building of the infrastructure for excellent fundamental and applied research and infrastructure for transfer of R&D

knowledge; clustering activities are supported through the Operational Programme Enterprise and Innovation (OP EI); there are new national R&D programmes that motivate enterprises to cooperate with research organisations in common projects.

- *Protection of intellectual property rights (IPRs) is underutilized and hence market for technology underdeveloped.* Among the top objectives of the Reform of the RDI System is to improve the commercialization of R&D outputs on the market for technology and innovation processes at large; new R&D support programmes, such as Alpha and Competence Centres launched by TA CR, require the utilization of R&D results, and motivate the participants to acquire IPRs; the sub-programme of the OP EI called Innovation enables beneficiaries to use the grant on IPRs; however, the number of international patents per capita remains low.

- *Future funding of new large R&D infrastructures*. Six major projects with a total subsidy of €835m, most of which comes from the OP RDI, are under construction. After five years, wage, maintenance and other operating expenses must be covered from other sources than the EU structural funds. Private funding is likely to cover only a small fraction. Unless the government significantly expands the amount of public R&D support, which is not likely to happen given the daunting budgetary pressures, there could be painful trade-offs at stake. Either the new projects or the existing infrastructure might need to shrink. It is not clear how this situation is going to be resolved.

Recently identified policy mix routes and their recent development include the following:

- *Stimulating innovative entrepreneurship*. New measures (e.g. pre-seed fund supported by the OP RDI and a seed fund financed from the OP EI) should be launched in 2013 in line with the implementation of the Strategy of International Competitiveness.

- *Boosting R&D investment in established firms.* The TIP and Alpha programmes administered by the MIT and TA CR, respectively, are the prime sources of public support for business R&D. Also parts of the OP EI are relevant to this issue. Finally, there is the tax credit scheme.

- *Attracting R&D-performing firms from abroad.* The system of investment incentives run under the Ministry of Industry and Trade (MIT) through CzechInvest has been recently focused on targeting R&D intensive projects. Foreign investors are allowed to use both direct and indirect fiscal support for R&D and acquire funds from European programmes.

- *Upgrading the public R&D infrastructure.* The OP RDI provides a significant amount of money for enhancing R&D capacity in the public sector; in particular, six large R&D infrastructures projects, which are going to have a profound impact on the whole R&D system, have been approved recently.

- *More business R&D carried out in cooperation with research organizations.* The TIP and Alpha programmes support co-operation of research organizations and firms. The Competence Centres programme launched by the TA CR is entirely devoted to promoting long-term partnerships between research organisations and the business sector. Also the large R&D projects currently being built with the support of the OP RDI are required to seek private co-financing.

Generally speaking, the above-mentioned challenges, policy mix routes and measures are aligned with the European Research Area's (ERA) objectives, despite in some respects the policy response has been piecemeal. National Research and Innovation Strategy on Smart Specialisation (RIS3), including 14 regional RIS3 strategies at the NUT3 level, is at an early stage of development, despite a need to embrace the RIS3 principles rather soon. Nevertheless, either way, the RDI policy mix in the following years is likely to concentrate on the support of innovative companies, RDI human resources development including the mobility issues, international as well as inter-sectoral co-operation in research, securing the sustainability of the large research infrastructures and the design of a new evaluation methodology of R&D results, which should lead to more effective distribution of RDI funds.

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1 INTRODUCTION

The Czech Republic is a small and open Central European country with land area of 77.3 square kilometres and population of 10.5 million people, accounting for 1.8% and 2.1% of the EU27 total, respectively. In 2011, gross domestic product (GDP) per capita in purchasing power standards (PPS) reached €20,200, 80% of the EU27 average. After real GDP dropped in the peak of the crisis by 4.5% in 2009, the economy slowly recovered by 2.5% and 1.9% in 2010 and 2011; however the positive trend reverted, as there is expected to be yet another decline by 1.3% in 2012 (Eurostat, 2013b).

Despite the sluggish economy, R&D intensity in terms of gross domestic expenditure on R&D (GERD) as % of GDP increased from the crisis bottom of 1.41 % in 2008 to 1.84% in 2011, getting significantly closer to the EU27 average of 2.03% but staying far from the national Europe 2020 target of 2.7%. In 2011, the business sector financed 47% of GERD, of which 98% was spend by the firms themselves, which testifies to their weak link to the rest of the system. Business enterprise expenditure on R&D (BERD) as % of GDP expanded to 1.11% in 2011 compared to 0.96% in 2010, approaching the EU27 average of 1.26%. In 2011, the government sector financed 37% and foreign sources accounted for 15% of GERD, the latter doubling from only 7% in 2008, which makes funding from abroad the most dynamic source (Eurostat, 2013a).

As far as R&D outputs, such as internationally recognized publications and patents, are concerned, there are several high-profile fields, which stand out in any ranking, including organic chemistry, nuclear physics, medical sciences, machine tools, measuring and testing, textile materials, electrical engineering, combustion engines and vehicles in general. Nevertheless, the Czech R&D system still lags far behind the top EU countries in terms of R&D outputs per capita, although the productivity is slowly catching up with the EU-27 average.

At the heart of the public R&D sector is the Academy of Sciences of the Czech Republic (ASCR), consisting of 54 research institutes, and 23 public, 2 state and 39 private universities. Unlike in Western Europe, research activities are concentrated under the umbrella of the ASCR, the primary mission of which is to conduct basic research, while the higher education sector has been traditionally less research-oriented and more focused on teaching. However, this has started to change in recent years, as the ASCR tends to get more involved in applied research and the university sector expands research activities.

In 2008, the Reform of the research, development and innovation (RDI) system was launched. The Reform profoundly changed the governance of the RDI policy and the responsibilities of the main players. More specifically, competences of particular governmental bodies in RDI policy are given by the Act No. 130/2002 Coll. on the Support of Research and Development from Public Funds and by the Reform amendment announced as Act. no 211/2009 Coll. As the result, the main players in RDI policy making are as follows:

Council for Research, Development and Innovation (CRDI) is an expert and advisory government body for RDI policy with 17 members chaired by the Prime Minister. At the political level, the CRDI plays the main strategic and coordinating role in the governance system.

Ministry of Education, Youth and Sports (MEYS) is the central administrative authority for R&D programmes in the public sector, particularly institutional funding for public universities. MEYS coordinates the EU Structural Funds through the Operational Programme Research and

Development for Innovation (OP RDI) and the Operational Programme Education for Competitiveness (OP EC).

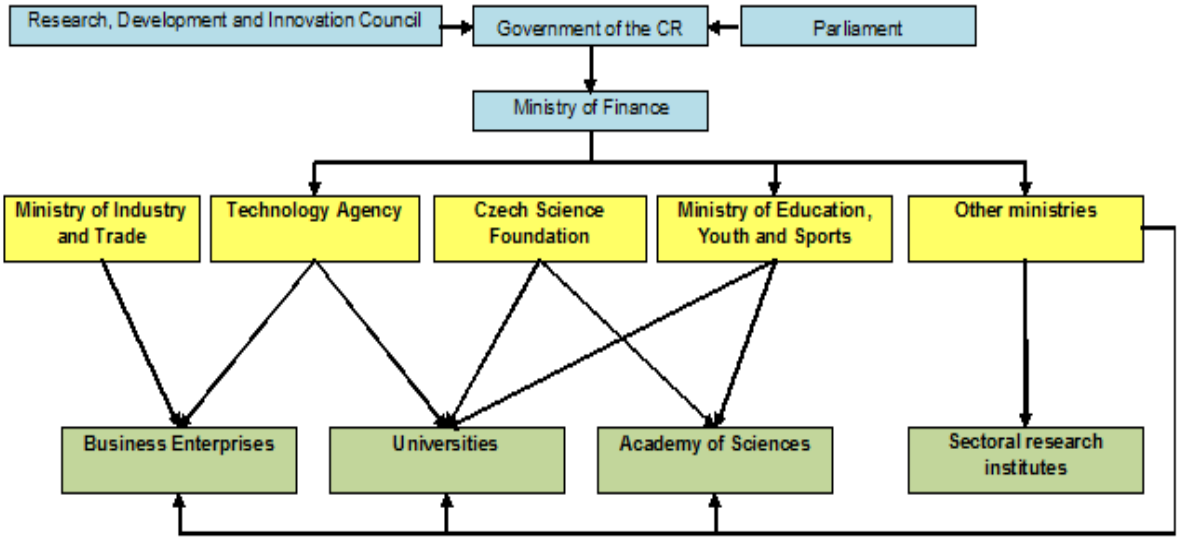
Ministry of Industry and Trade (MIT) is responsible for policies in the domain of business R&D and innovation. MIT coordinates the EU Structural Funds through Operational Programme Enterprise and Innovation (OP EI).

Technology Agency of the Czech Republic (TA CR) provides competitive funding for applied research and experimental development.

Czech Science Foundation (GA CR) provides funding for competitive grants in basic research.

Academy of Sciences of the Czech Republic (ASCR) is a conglomerate of 54 formally independent public research institutes, which together represent by far the most important public research performer.

Figure 1: Overview of Czech Republic's research system governance structure



Source: ERAWATCH Research and Innovation Inventory (2013)

RDI policy making is fairly centralized. Regional authorities, the self-governing regions at the NUTS-III level, do not have any legally binding responsibilities in this respect. At the regional level, the role of RDI policy is limited to coordination of the national programmes and the implementation of regional development policies. Nonetheless, the law does not prevent the regional authorities from launching their own RDI policy initiatives, though only a very few have done so.

2 RECENT DEVELOPMENTS OF THE RESEARCH AND INNOVATION POLICY AND SYSTEM

2.1 National economic and political context

Real GDP growth was high for nearly a decade, annually on average about 4.5% over 2000-2008, which was well above the EU27 average. However, the slump in export demand during the global economic crisis hit the economy hard and GDP dropped by 4.5% in 2009; despite the fact that the domestic financial sector did not face major difficulties thanks to the cleanup about a decade ago. In 2010 and 2011, the economy recovered at a slow pace with GDP growing by 2.5% and 1.9%, respectively, however only to plunge into a double dip recession, as in 2012 according to Eurostat's prediction GDP is expected to decline by 1.3% again (Eurostat, 2013b).

The center-right government spearheaded by the Prime Minister Petr Nečas has been significantly reshuffled since mid-2011. Most importantly, heads of the two core ministries involved in RDI policy making, i.e. MEYS and MIT, have been changed. Petr Fiala, professor of political sciences and the former dean of the Faculty of Social Studies at the Masaryk University, has replaced Josef Dobeš in the helm of the MEYS in May 2012. Martin Kuba, physician and the former first deputy of the regional government in South Bohemia region, has replaced Martin Kocourek as the head of the MIT in November 2011. Also there were major changes in the composition of the CRDI Council in 2011. However, this has not been accompanied by a major shift in RDI policies.

2.2 Funding trends

In 2011, gross domestic expenditure on R&D (GERD) amounted to €2.9b and increased by about one fifth as compared to the previous year, driven mainly by the expansion of business and foreign funding, which represents the highest annual growth recorded in five years and a promising signal of recovery in R&D spending. As the consequence, R&D intensity of the economy in terms of GERD as % of GDP increased to 1.84% in 2011, as compared to 1.41 % at the dawn of the crisis in 2008, hence noticeably approaching the EU27 average of 2.03% according to the latest available Eurostat's estimate. However, the R&D intensity of the economy is still far from the target of 2.7% outlined in the Europe 2020 initiative (Eurostat, 2013a).

Business enterprise expenditure on R&D (BERD) accounted for 60% (€1.73b) of the total, the higher education sector came second with 22% (€0.62b) closely followed by the public research institutions with 18% (€0.50b), while the private non-profit sector remained negligible accounting for less than 1% (€0.01b) in 2011. BERD as % of GDP reached 1.11% in 2011, which represents a significant increase compared to 0.96% in 2010, the crisis bottom of 0.87% in 2008, and about 0.70% ten years ago. BERD is characterised by a level of domination by foreign-owned companies that is one of the highest in the EU, as nearly 60% is performed by foreign affiliates, which represents a particular challenge for the design of RDI policies (Eurostat, 2013a).

In 2011, the business sector financed 47% (€1.35b) of GERD, of which 98% was spend by the firms themselves, most of the remaining 2% went to the public research institutions and only slightly less than 0.5% flew to the higher education sector, which testifies to the very weak link

between the business sector and other parts of the system. The government sector funded 37% of GERD (€1.06b), most which became split between higher education (42%) and public research institutions (37%). Foreign sources contributed by 15% (€0.44b) of GERD funding, doubling from only 7% in 2008, about 40% of which came from private and 60% from public foreign sources; predominantly the EU funds, which is a major shift as the private segment dominated in previous years (Eurostat, 2013a).

Government budgetary appropriations or outlays for R&D (GBAORD) amounted to €1.05b and the intensity of the economy in terms of GBAORD as % of GDP reached 0.68% in 2001, which represents a significant increase from 0.53% of GDP in 2008, hence largely narrowing the gap as compared to the EU27 average of 0.73%, despite major cuts in other parts of the government budget (Eurostat, 2013a). However, GBAORD are expected to stagnate at €1.06b and 0.69% of GDP in 2012. Likewise, the amount of GBAORD approved in the 2013 public budget and earmarked by the government for the years 2014 and 2015 has been frozen at about €1.03b (CRDI, 2012a). Hence, GBAORD is likely to stay at roughly the same level in foreseeable future.

	2009	**2010**	**2011**	**EU27**
GDP growth rate	-4.5	2.5	1.9	- 0.3 (2012)
GERD (% of GDP)	1.47	1.55	1.84	2.03s (2011)
GERD (euro per capita)	200.0	222.2	273.0	510.5s (2011)
GBAORD - Total R&D appropriations (€ million)	870.3	893.9	1,048.3	91,277.1 (EU27 total 2011)
R&D funded by Business Enterprise Sector (% of GDP)	0.66	0.76	0.86	1.26 (2011)
R&D performed by HEIs (% of GERD)	18.1	18.0	21.6	24% (2011)
R&D performed by Government Sector (% of GERD)	21.4	19.4	17.5	12.7% (2011)
R&D performed by Business Enterprise Sector (% of GERD)	60.0	62.0	60.3	62.4% (2011)
Share of competitive vs institutional public funding for R&D (% of GBAORD)	44.2	46.5	48.1	n/a

s - EUROSTAT estimate

Data Source: EUROSTAT (2013a) and (CRDI 2012a), March 2013.

The Czech system of public R&D funding has been traditionally dominated by institutional support. However, this is changing in the context of the Reform of the RDI System. As the result, the share of institutional funds in GBAORD decreased in the last few years, namely from 56% in 2009 to 52% in 2011. According to the GBAORD plans approved by the government, the share of institutional funding should continue to decrease to 51% in 2012, 50% in 2013 and further drop to 47% in 2014 and 2015. The largest share of institutional funding is distributed between the ASCR and the MEYS which, in turn, forward the money to individual recipients, predominantly public research institutes and universities (CRDI, 2012a).

In 2012, the single largest recipient of institutional funds is earmarked to be the ASCR with CZK4.5b (€179m), which constitutes the vast majority of its annual budget and about 33% of the total institutional funding. In 2013, the budget of the ASCR and the respective proportions

are planned to remain roughly the same. It is interesting to note that a part of this funding is re-distributed between the public research institutes within the ASCR based on its own internal methodology, and hence its own policy in this respect. Overall, however, the largest share of the institutional funding, about 56% and CZK7.5b (€300m) in 2012 and 54% and CZK6.9b (€276m) in 2013, is channelled by the MEYS. Much smaller amounts are channelled through other ministries which provide institutional funding mainly to research centres controlled by them (the Ministry of Agriculture, the Ministry of Culture, the Ministry of Health and others).

The main providers of project-based funding of a bottom-up type, i.e. competitive research grants driven by the intentions of applicants, are the GA CR which allocates grants for basic research and the TA CR which supports applied research and experimental development. GA CR has an annual budget of CZK 3.0b (€120m) and CZK 3.3b (€132m) in 2013. The legal statute of TA CR was adopted by the government in December 2009 and the first programme Alpha was launched in March 2010. The first projects were selected in November 2010 and started at the beginning of 2011. Another three programmes funded by TA CR called Beta, Omega and Competence Centres were launched during 2011-2012. As the result, the budget of TA CR has grown significantly in recent years. In 2011, the budget was CZK 0.9b (€34m). In 2012, the approved budget reached CZK 2.2b (€86m). In 2013, the budget is earmarked to further increase to CZK 2.6b (€102m).

Yet a major part of project funding for applied research is still administered by the MIT, primarily through the TIP research programme with a budget of CZK 3.0b (€121m) in 2012, which however has been significantly reduced in the medium-term budget plans and hence is going to expire in the coming years. As soon as this programme is finished, MIT is supposed to cease the administration competitive R&D funding and completely pass this role to the TA CR. Also the MEYS has a significant budget devoted to project-based funding, which is consumed primarily by the higher education sector, namely CZK 3.5b (€140m) in 2011, CZK 2.6b (€103m) in 2012 and CZK 2.8b (€113m) in 2013.

Much smaller amounts are channelled by five other ministries which provide competitive funding through their individual research programmes (the Ministry of Agriculture, the Ministry of Culture, Ministry of Defence, Ministry of Health and Ministry of Interior). As past experience has shown, however, these programmes while nominally competitive funds are often used as a source of institutional funding for some selected research institutes controlled by the given ministries and also as a means of research funding for the needs of the respective ministries.

Thematic funding programmes are underdeveloped and the thematic focus is not very strongly promoted by the existing funding sources. Nonetheless, some thematic programmes do exist in competence of several ministries such as the Ministry of health, the Ministry of Culture etc. Hence, the share of public resources spent on thematically non-oriented research far exceeds expenditures on oriented research. According to the shares of socio-economic objectives (NABS), non-oriented research had 25.6% share on GBAORD in 2011, followed by the research financed from general university funds with 30.4% share. Within thematically oriented research, representing the remaining 44.0% of GBAORD, prevails industrial research (14.8% of the total GBAORD), followed by medical research (6.1%), agricultural research (4.0%) and research in the field of energy production, distribution and utilisation (3.2%). Other socio-economic objectives have a combined share of 16% on the total GBAORD (CZSO, 2012a).

The role of the EU structural funds in the funding of R&D has grown enormously in the new programming period 2007-2013. Public R&D activities are financed particularly by two OPs administered by the MEYS: OP RDI (ERDF) and OP EC (ESF). The combined allocation of these two OPs equals approximately €3.8b. Business R&D and innovation activities are financed

through the OP EI administered by the MIT with a total budget of approximately €3b for RDI relevant activities. Innovation activities with only a small fraction of possible R&D financing are also supported by the OP Prague -Competitiveness (OP PC). By February 2013, Czech participants active in projects funded under the 7th Framework Programme acquired support of €209m from the EU (total project costs of €286m), participating in 893 projects (Technology Centre ASCR, 2013).

Finally, R&D tax credit scheme, hence indirect fiscal R&D support, to stimulate private R&D efforts has been launched in 2005. The new tax regulation enabled enterprises to deduct expenditures on R&D carried out for their own needs from their tax base, a major change as there was no measure of this kind before. In 2005, 27% of R&D active businesses used the tax relief. In 2010, the number of companies drawing on indirect support to R&D was already 35% of companies performing R&D activities, the total indirect support of R&D reached almost CZK 1.33b (€54m) and the tax deductible amounted to CZK 7.0b (€285m). By far the highest share of R&D active firms, which use the indirect support, is in the group of small enterprises up to 50 employees; hence this instrument proves to be particularly suitable for promoting R&D in small firms (Peroutková, 2012).

2.3 New policy measures

In 2012, three new programmes managed by TA CR were launched: i) BETA is a programme of public procurement in research, experimental development and innovation for the needs of public administration bodies, approved for the period 2012 to 2016 and with a budget of €26m over the five years; ii) OMEGA supports applied social science research and experimental development, is approved for the period 2012 –2017 and the budget is only a little over €2.5 million in the first year; and iii) Competence Centres supports RDI centres in progressive fields with strong application potential and with conditions for the development of long-term collaboration between the public and private sectors, approximately 35 centres are supported with a budget of about €240m over 2012 to 2019.

On 20 December 2012, the government approved an action plan for 71 measures to promote growth, entrepreneurship and employment. The measures are organized in five key areas: i) Reduction of regulatory burden; ii) Strengthening of competitiveness and extending tax credits; iii) Support for innovation; iv) Export promotion; and v) Efficient use of the EU funds. More specifically, the government aims to launch a new program promoting technical education, including lifelong learning, design a new program promoting applied research in the business sector, implement tax credit scheme to support cooperation of businesses with the sector of secondary and higher education and extend the existing R&D tax credits to purchase of external R&D services from research organizations.

The MIT has announced plans to launch a pilot project of a public-private seed fund aimed at boosting the grossly underdeveloped national market for venture capital and supporting the creation of new knowledge-based companies, including university and research spin-offs. The pilot project has been presented at 15 universities during the autumn of 2012 and is expected to start in the second half of 2013. According to preliminary figures, a budget of approximately €53m is earmarked for the seed fund, most of which (about 85%) should come from OP EI and the rest from the state budget.

2.4 Recent policy documents

In the context of the National Policy of RDI 2009-2015 implementation, new long-term national priorities of oriented RDI (for the period until 2030) were prepared by panels of experts at the end of 2011. More specifically, the priority research fields were identified within six broader areas: i) Knowledge Economy; ii) Energy; iii) Natural Resources; iv) Social Sciences; v) Health; and vi) Security Research. The identified set of priority research fields was approved by the government's resolution no. 552 in July 2012. According to the resolution, the governmental ministries, ASCR, GA CR as well as TA CR have responsibility for implementing the priorities within their authority, namely during the preparation of new RDI programmes. Furthermore, the priorities will be taken into account during the update of the National RDI policy 2009-2015 and the preparation of proposal of state budget expenditures for 2014 and later.

National Innovation Strategy of the Czech Republic (NIS) has been published in October 2011. The Resolution of the Government no. 77 of 26 January 2011 assigned the MIT and MEYS to prepare this document in line with recommendations of the Innovation Union (2010) strategy of the EU and as an integral part of the International Competitiveness Strategy of the Czech Republic (ICS). NIS was approved by the Government's resolution no. 714 of 27 September 2012. At the conceptual level the strategy indentifies four priority areas: i) Excellence in research; ii) Cooperation and knowledge transfer between academia and industry; iii) Support for innovative entrepreneurship; and iv) People as carriers of new ideas and initiators of change. The strategy provides a base for the forthcoming update of the National RDI Policy 2009-2015.

2.5 Research and innovation system changes

New large R&D infrastructure projects that are going to have a profound impact of the whole R&D system have been approved for funding in 2011 and 2012. By December 2012, six major projects with a total amount of subsidy of €835m (85% funded by the ERDF) were approved: i) ELI - Extreme Light Infrastructure (€271m); ii) BIOCEV - Biotechnology and Biomedicine Research Centre (€92m); iii) CEITEC - Central European Institute of Technology (€209m); iv) Centrum excelence IT4Innovations (€72)m; v) ICRC - International Clinical Research Center (€94m); and vi) Udrzitelna energetika (€97m). The projects are financed by the OP RDI, through the Priority Axes 1 and 2. For more information see the Annual Report on Implementation of the OP RDI for 2011 (MEYS, 2012).

As the result of the implementation of the Reform of the RDI System, the number R&D budget providers have been halved to 11 in the budget period 2013-2015. The responsibility for administrating public support for applied research and innovation is moving under the umbrella of the TA CR, which gradually takes this responsibility over from ministries and other state institutions. Therefore, the budget of the TA CR grows, while the R&D budget earmarked for competitive funding of applied research of ministries declines, especially of the MIT, which used to be the main provider of funds for the support of industrial research. On the other hand, the MEYS and MIT administer large OPs of the EU structural funds dealing with R&D and innovation, therefore there is significant dynamics of expenditure within these programmes as the national public co-financing is required.

2.6 Regional and/or National Research and Innovation Strategies on Smart Specialisation (RIS3)

Regional authorities, consisting of 14 self-governing regions at the NUTS3 level, do not have any legally binding responsibilities in RDI policy. Yet the law does not prevent them from launching own RDI initiatives, which is, however, difficult given their restricted budgets. So far their main role has been in catalyzing the EU Structural Funds projects, primarily those funded from the OP RDI. South Moravian region is the main exception that proves the rule, representing the national role-model of regional innovation policy with dedicated authorities, well functioning innovation agency and dialogue with the business community; for more information see (RISJMK, 2013). Several other regions are attempting to emulate this model with various degrees of success, most prominently Moravia-Silesia, Liberec, Zlín and Hradec Králové regions, while most of the other regions have either only paid a lip service to developing regional innovation policy or ignored this policy area altogether, such as Central Bohemia, Vysočina and Plzeň regions.

National RIS3 strategy, as an annex to which will be produced regional RIS3 strategies, is due to be announced by the end of 2013. MEYS has accepted the responsibility for designing the RIS3 strategy and appointed a coordination board in November 2012. The national RIS3 facilitator and regional RIS managers are expected to be selected during the first half of 2013; thus arguably facing a very tight schedule. The regional managers will be appointed and funded by the MEYS, so there formally will be 14 regional attachments to the national RIS3 report, but it remains to be seen to which extent a top-down initiative of this kind will make a tangible difference on the ground, especially in the regions where indigenous initiative has been limited so far. Admittedly, only South Moravia and the Capital City of Prague have started to work on their RIS3 strategies in a genuinely bottom-up manner, independently of the national push; the testimony to which is the fact that only these two regions have registered in the S3 (Smart Specialisation Strategies) Platform initiative of the JRC by March 2013.

RDI policy making is fairly centralized. So far co-ordination between the national and regional level innovation strategies has been very weak, if not missing altogether. National innovation strategy has addressed the regional aspects of innovation vaguely only. Drafting of the national RIS3 strategy involves, at least formally, a co-ordinated action of the national and regional authorities on the topic of innovation policy; hence representing a much needed opportunity for establishing a nation-wide debate on this topic. Needless to say, it is pertinent that this dialogue is sustained beyond this particular purpose and elements of multilevel governance of the RDI system are implemented in the future.

2.7 Evaluations, consultations

The International Audit of the RDI System of the Czech Republic (Arnold, 2011) carried out for the MEYS by Technopolis and MIOIR Manchester with the support of the Technology Centre of ASCR in 2010 and 2011. The main recommendations were presented in October 2011 as follows: i) The promised civil service reforms should urgently be carried out; ii) The state should continue to increase its investment in R&D; iii) The organisation, performance and division of labour among the universities, ASCR and RTOs should be reviewed; iv) Ministry capacities to act in RDI should be strengthened; v) R&D programming practice should respect the international tradition of stakeholder involvement; vi) Institutional funding should comprise at least 50% of research funding; vii) The evaluation methodology should be replaced by a system of performance contracts; viii) Evaluation practice should be the subject of root and branch

reform, refocusing on outcomes and impacts in addition to outputs; ix) CRDI should generate a RDI internationalisation strategy and x) The employers' organisations or chambers of commerce should launch a campaign of IPR education for industry.

2.8 Policy developments related to Council Country Specific Recommendations

Recent debates about the need to reduce the share of institutional funding in favour of funds allocated for project funding distributed on a competitive basis has resulted in a proposal to reform the system of institutional funding. As a part of the Reform of the RDI System, it has been decided that each research organisation receives institutional funds based on its historical research results achieved over the past five years, as reported to the central database of research results. However, this new system of quality evaluation of higher education and research institutions has been hotly debated topic in recent years. It has been heavily criticized by the academic community for being too mechanistic and for not taking into account differences in publication (and citation) behaviour between different fields of science, among other things. It has been also criticized in the International Audit of Czech RDI, one of which recommendation was to fundamentally review the system and replace it by replaced by a system of performance contracts.

As the result, this system of distribution the institutional funding has been largely abandoned in the budget period 2013-2015. More specifically, the formula used over this period is based on the compromise between the need to use quantitative criteria (as required by the law) and other considerations, as the results of which 80% of the money has been divided in the same way as in the 2011 budget and only 20% has been divided based on the historical research results achieved over the previous five years (CRDI, 2012a). Admittedly, the 80/20 division was a result of a negation between the respective stakeholders. Hence, in a way, the currently distribution of the funding is based on a consensus between the main policy actors, rather than on the quantitative data. A project (as a part of the OP RDI) intended to conduct more systematic revision of the methodology is in the making now. The results are expected sometimes in 2013. On the base of this should be adopted the new legislation as outlined din the CSR recommendations.

3 STRUCTURAL CHALLENGES FACING THE NATIONAL SYSTEM

According to the Innovation Union Scoreboard 2011 (European Commission, 2012), the Czech Republic is classified in the "moderate innovators" category with the overall innovative performance below the EU-27 average. Nevertheless, the Czech Republic ranked on the 8th place in terms of the performance growth over the previous five years. Strengths are in Human resources (youth secondary education), Firm investments (non-R&D innovation expenditures), Innovators (non-technological innovation) and Economic effects (high-tech exports and innovative sales). Weaknesses are concentrated in Open, excellent and attractive research systems (top scientific publications and non-EU doctorate students), Finance and support (venture capital) and Intellectual assets (patents, trademarks, etc.). High growth is observed in tertiary education, trademarks and (from a very low base) in venture capital.

Many analyses of the RDI system have been recently carried out in the context of the ongoing reform by (or in cooperation with) by the Technology Centre of ASCR, notably the International Audit of RDI in the Czech Republic summarized by Arnold (2011), which has pinned down the key policy challenges in the most comprehensive way so far. Moreover, there are the twin documents Competitiveness Report by the National Economic Council (2011) and Strategy of International Competitiveness by MIT (2011a), including the follow-up National Innovation Strategy produce jointly by MEYS and MIT (2011b), which scrutinize the role of RDI in the broader policy context. Drawing on their findings, which are by and large in parlance with results of European Commission (2012) and with each other, the main structural challenges can be summarized, not necessarily in the order of importance, in six areas as follows.

Governance and public funding

At the present time governance of the national system is undergoing a profound reform outlined in the National RDI Policy of the Czech Republic 2009–2015 (CRDI, 2009). RDI funding system has been streamlined. TA CR has been established as the dominant supporter of applied research. The role of ministries has been gradually reduced, especially in favour of the CRDI, GA CR and TA CR. The CRDI has centralised principal activities, become effectively responsible for setting the entire national research budget and de facto assumed the role of a science ministry. However, the CRDI formally continues to be an advisory body of the government only; without adequate executive administration, analytical capabilities and budget line, which inhibits its capacity to make informed decisions on long-term strategy development. The CRDI has become overburdened with responsibilities, which it struggles to cope with given the limited resources.

A particularly thorny liability of the CRDI, which haunts the policy debate for several years, is the dysfunctional evaluation methodology of research institutions, which determines the allocation of public institutional funding. The current formula-based approach that has been implemented early in the reform automatically reallocates the entire flow of institutional funding annually based exclusively on outputs generated in the preceding five years. The idea was to make the allocation performance-based, which in turn was expected to reward quality, boost productivity and de-politicise the funding process. But the methodology that has been put in place has been fiercely resisted by the stakeholders and criticized as simply "not fit for the purpose" by Arnold (2011) for falling into the trap of reductionism, creating inherent instability of the funding flows, failing to address differences between fields of science, stimulating

opportunistic behaviour, ignoring national thematic priorities and in general terms for focusing on immediate outputs at the expense of losing the sight of the intended societal effects.

As the result, the strategic policy-making has been complicated, if not largely paralyzed, by fights among members of the CRDI over the evaluation methodology. More recently, the institutional funding flow has been refined for the budget period 2013-2015, by introducing a short-term patch into the formula that redirects the flows in a way agreed in political negotiations among the key stakeholders, which effectively means that the current system has been abandoned without replacing it by a new one. It is not clear what happens beyond this horizon. Overall, this stalemate locks the stakeholders in short-term focus and represents a major impediment for tackling many other problems that are intimately related to incentives laid down in the evaluation.

Arnold (2011) concluded that the political instability in recent years had a major negative impact on the RDI system. There have been frequent changes of ministers that make it difficult to implement consistent policy. All too often, the reform debates have been politicised and the decision making process dominated by interest groups, not based on strategic intelligence and dealing with the problems in a systematic manner. Many of the unresolved issues are symptoms of a lack of trust among the key actors, especially the lack of trust in the government, which thwarts attempts to make deeper changes in the system. In the meantime, public RDI funding is expected to stagnate in the medium-term outlook, and hence unless there is a breakthrough, the prospects for reaching the 2020 national target of 1% of GBAORD as % of GDP remain rather bleak.

RDI human resources

The lack of highly skilled personnel is often cited as not only hampering the quality of research in PROs but even more so as the major obstacle of innovation in the private sector. According to the data from CZSO (2012b) and the assessment of MIT (2011b), the number of PhD graduates has stagnated in recent years, there is a long-term tendency for the proportion of science and technology tertiary students to decrease in comparison to those of social science and humanities, and because the reform of tertiary education remains uncompleted, there has been an unchecked expansion of university graduates over the last decade or so, the quality of which is however hard to judge. As shown by National Training Fund (2012), moreover, opportunities for early career researchers are weak, post-doc funding remains limited and especially in the university sector often not allocated on competitive basis, which leads to in-breeding. Arnold (2011) reported that management of research groups is underdeveloped, the groups tend to be very small, locked into existing research trajectories, lacking interdisciplinarity and there is little use of career development plans; this is partly because of weak bottom-up incentives, lack of internationalisation strategies and poor mobility among researchers. Overall, the approach to RDI human resource management is unsystematic.

Technological capabilities, multinationals and venture capital

A major policy shift promoted by the RDI reform has been from a system traditionally focused on science towards more attention devoted to boosting innovation. But the success has been at best partial so far. Arnold lamented (2011) that the economy is based on diffusion and absorption of technologies that are new to the firm or new to the country but not new to the world and concluded that domestic knowledge generation has not been yet established as the main driver of growth. Most R&D done by enterprises is limited to experimental development rather than research. Almost 60% of business R&D is performed by foreign affiliates. As noted by MIT (2011b), however, foreign affiliates are largely doing low-added value work, even within

high-tech industries, as the parent companies tend to keep the core research activities close to their headquarters abroad. From this follows the challenge to make the multinationals more embedded in the national innovation system and upgrade the activities they perform locally.

European Commission (2012) testifies to the fact that utilization to venture capital to support innovative businesses and spin-off firms trying to commercialize research outcomes is one of the lowest among European countries and that limited access to external sources of finance for innovation is perhaps the single most important obstacle for improving the innovative performance of indigenous firms. Unfortunately, a lack of experience among potential clients and rather traditional entrepreneurial culture do not form an environment favourable to venture capital expansion. Public support measures to boost access to venture capital remain completely missing; despite recurring plans to launch a public seed fund, which could kick-start the market, but which however has not been put into operation yet. Despite the business R&D spending has increased noticeably in recent years, the limited venture capital market makes this trend unsustainable, and unless this obstacle is addressed, the ambition of spending 2% of GDP on R&D, as delineated in the Horizon 2020 policy of the EU, is far out of reach.

Public-private collaboration

Public-private linkages are underdeveloped. Given the historical separation of science and business and the prevailing differences in culture or attitudes in these spheres, the lack of collaboration between them is one of the main issues in innovation policy. In spite of a steady effort to strengthen public-private links, deficiencies are present on both sides, namely poor commercialisation endeavour and limited industry-valuable results in the public sector on one hand and low ability to look outside the firm, identify and exploit knowledge in companies on the other hand. Since the business sector tends to lag behind the technology frontier, except perhaps of the dis-embedded multinationals, most of the firms focus on absorbing existing technologies rather than collaborating with science. Poor mobility of professionals between the sectors and sometime too rigid setting of support measures only reinforce the weaknesses.

All too many public-private linkages are informal. MIT (2011b, pg. 7) account of this situation speaks volumes about the poor management of public-private linkages: "A very important mechanism of knowledge transfer in the Czech Republic is informal networks based on personal contacts. The problem is that collaboration happens between individuals and not between enterprises and research organizations. Hence, the outcome is often what can be described as "privatization of outputs of public research activities". Research organizations suffer a loss of potentially significant source of income. Moreover, these issues generate personal conflicts in research teams. For many public researchers these informal linkages represent the main source of their personal income, which in turn limits the time they devote to science itself." Generally speaking, the lack of rules, their inadequate enforcement and ineffective administrative processes that creates fertile ground for opportunistic behaviour of actors involved on both sides represent a major impediment for formal public-private collaboration.

Intellectual property rights, technology transfer and market for technology

Formal methods of intellectual property rights (IPRs) protection, in particular patents and their licensing, are underutilized, as clearly shown by European Commission (2012), in spite of the continuous effort to improve the use of public R&D outputs in innovation processes and despite the fact that state of the art IPRs legislation is in place. Yet few experts and little experience can be found in this field, especially in the public sector, except only perhaps of a few exceptions under the umbrella of ASCR that prove the rule. Poor commercialisation of R&D outcomes in

general requires systematic attention as well as support to research excellence to produce high valuable research outcomes being worth of patenting costs.

Furthermore, there is a lack of organisations supporting knowledge transfer in practice. Supply of mediation services provided to innovative companies is insufficient. There are unfavourable conditions, including legal impediments, for setting up academic spin-offs. Technology Transfer Offices are in infancy in the public sector, as the results of which there is insufficient experience on how to trade patens and licenses on the market for technology. Knowledge transfer incentives are usually set through internal payroll regulations and other internal regulations defining remuneration of researchers including extraordinary bonuses related to successful transfers, patents, licences etc. However, these practices differ by organization, thus there are no generally accepted standards of behaviour. Systematic solution of the technology transfer issues at the national level, hence an explicit national knowledge transfer policy, is lacking.

Sustainability of new large R&D infrastructures

Large R&D infrastructural projects that are currently under construction with the support from the EU Structural Funds, for more information see Section 2.5 on Research and innovation system changes; provide a major promise for boosting the research output. However, the new projects represent a major funding puzzle, because the EU support is for the initial investment only. Later on, wage, maintenance and other operating expenses must be covered from other sources. So there is a tangible danger that these large projects turn from blessing to a curse for the public R&D system, as sizeable opportunity costs are likely to appear in not too distant future. Managers of the projects pledge to obtain funding from private sources. But this is likely to cover only a fraction of their needs. More likely is that their operating costs will start draining public R&D funding from the existing infrastructure. Unless the government noticeably expands outlays for R&D, which is not likely to happen in the near future, there could painful tradeoffs at stake. Either the new projects or the existing infrastructure might need to shrink; possibly quite significantly. And in the final analysis this can have major disruptive impact for functioning of the national innovation system.

Another critical bottleneck for their success that should be mentioned is availability of qualified human resources, not to mention star scientists, on the labour market. Arguably, this is can turn out to be a major problem in some of the large research centres, as the expected demand by far exceeds domestic supply in the relevant scientific fields. Some of the new staff will have to be poached from the existing infrastructure. Some of them, perhaps even their majority, will have to come from abroad. But attracting large numbers of top foreign researchers in a relatively short span of time required for launching the full operation of the projects is not going to be easy, if one considers the above mentioned funding uncertainties, because of the fact that the wage level of scientist is far below the European average and in projects located far from the capital city of Prague, which proved to be attractive location for foreigners by itself.

HUMAN RESOURCES	
New doctorate graduates (ISCED 6) per 1000 population aged 25-34	1.3
Percentage population aged 25-34 having completed tertiary education	20.4
Open, excellent and attractive research systems	
International scientific co-publications per million population	497.5
Scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country	486.0
Finance and support	
R&D expenditure in the public sector as % of GDP	0.58
FIRM ACTIVITIES	
R&D expenditure in the business sector as % of GDP	0.97
Linkages & entrepreneurship	
Public-private co-publications per million population	24.7
Intellectual assets	
PCT patents applications per billion GDP (in PPS€)	0.93
PCT patents applications in societal challenges per billion GDP (in PPS€) (climate change mitigation; health)	0.14
OUTPUTS	
Economic effects	
Medium and high-tech product exports as % total product exports	62.1
Knowledge-intensive services exports as % total service exports	38.0
License and patent revenues from abroad as % of GDP	0.06

Note: The latest year available.
Data Source: European Commission (2012).

4 ASSESSMENT OF THE NATIONAL INNOVATION STRATEGY

4.1 National research and innovation priorities

National RDI Policy of the Czech Republic 2009–2015 (CRDI, 2009) is the central policy document, the elaboration of which has reflected a growing need to possess a strategic document, which would fully encompass the entire sector of research, development and innovation, and which would substitute various partial strategies concerning that preceded it. CRDI (2009) has been developed in the process implementation of The Reform of the RDI system in the Czech Republic (CRDI, 2008a), which was approved by the Government in 2008.

National RDI Policy consists of nine main objectives:

- Establish a strategic management of RDI at all levels based on systematic impact assessment of the National Policy as well as analyses of RDI;
- Target the public support to RDI in line with demands of sustainable development;
- Increase the efficiency of the public support to R&D;
- Utilize the R&D results in innovation processes and enhance the co-operation of the public and private sector in RDI;
- Intensify the involvement in the international RDI co-operation;
- Provide qualified human resources for RDI;
- Create an environment stimulating RDI;
- Ensure the compatibility and linkages of the National Policy with other sectoral policies;
- Ensure consistent evaluation of the RDI system.

New R&D programmes developed under the new RDI policy were supposed to follow the Priorities of the Applied Research, Development and Innovation for 2009-2011 (CRDI, 2008b). However, the reality was rather different. The identified priorities were considered to be too broad; their set up had covered almost all science and research fields and their application into the subsequent research programmes did not function well. Hence, in 2012, the priorities were updated in the document National Priorities of Oriented Research, Experimental Development and Innovation (CRDI, 2012b), which sets new long-term national priorities of oriented RDI for the period until 2030 in six areas as follows:

- Knowledge Economy
- Energy
- Natural Resources
- Social Sciences
- Health
- Security Research

The Priorities of Oriented Research (unlike the previous Priorities of Applied RDI) reflect major societal challenges and needs of the society as concrete goals solvable through RDI in available capacities and are set for the 15-20 years' time horizon. Neither of these documents, however, set any binding or quantified targets for the given priorities. The new priorities should be respected in providing public RDI support, including designing new programmes and providing institutional support. The priorities will also be taken into account during the update of the

National RDI policy and the preparation of proposal of state budget expenditures in the following years. Responsibility for the process of priority setting lies with the CRDI.

The Government adopted a comprehensive long-term Strategy of International Competitiveness in 2011 (MIT, 2011a), which addresses issues relevant to innovation performance in a broad sense given by improving the environment (regarding institutions, infrastructure, education, financial market, etc.) rather than by a simple financial support to innovation. The core of the Strategy called "3i" deals with institution, infrastructure and innovation – the three pillars which are frequently indicated as the main weaknesses of the present system (see e.g. lack of trust among actors, insufficient support to excellence in research, poor commercialisation effort and unavailability of venture capital). Concrete goals of the Strategy in respect to innovation are:

- To increase the demand for innovation;
- To increase awareness and motivation for cooperation between research institutions and the business sector;
- To create financial, material and personnel conditions for the development of excellent research;
- To target the public support to business and research primarily in respect to the identified key technology areas; and
- To create a functional system for effective management of development policies and support instruments for innovative businesses and R&D.

In parallel, the National Innovation Strategy (MIT, 2011b) was coproduced by the MEYS and the MIT and approved by the Government in 2011. It develops in more comprehensive way the innovation pillar of the Strategy of International Competitiveness. MIT (2011b) provides an overview of the innovation field and contains various measures divided into four main priority axes: excellent research; cooperation between business and research sector and knowledge transfer; innovative entrepreneurship; and human resources for innovation.

ERAWATCH country reports (2010 and 2011) identified policy mix routes covering the major ways of increasing public and private R&D expenditures that remain highly relevant as follows:

1. Promoting the establishment of new indigenous R&D performing firms;
2. Stimulating greater R&D investment in R&D performing firms;
3. Stimulating firms that do not perform R&D yet;
4. Attracting R&D-performing firms from abroad;
5. Increasing extramural R&D carried out in cooperation with the public sector or other firms; and
6. Increasing R&D in the public sector.

Table 1: Importance of routes in the national policy and recent changes

Route	Short assessment of the importance of the route in the national policy	Main policy changes since 2009
1	Important, but relatively small in terms of budgetary weight.	The major use of EU Structural Funds is to support business R&D. New measures (e.g. pre-seed fund supported by the OP RDI) should be launched in 2013 with the implementation of the Strategy of International Competitiveness. Tax measures to maintain the company conducting the R&D will be extended on buying external R&D yet.
2	Very important, also in terms of budgetary weight (via OP Enterprise and Innovation).	Through the TIP programme allocates the MIT support to companies that carry out R&D. More interest to this route has been devoted through the Alpha programme requiring co-financing by enterprises, which is a traditional mean how to stimulate private investment to R&D. Also parts of the OP EI are relevant to this issue.
3	Relatively high importance but relatively small in budgetary weight.	The TIP programme as well as the Alpha programme is open to enterprises that have never performed R&D, but there is no special attention paid to R&D beginners in any support measure in the Czech Republic.
4	Important, but relatively small in terms of budgetary weight.	The investment incentives run under the MIT through CzechInvest Agency have recently oriented to attract more R&D intensive investments. Tax incentives for the implementation of R&D activities can be also used by firms abroad operating in the Czech Republic.
5	Very high importance (included in almost all policy documents in the field of R&D).	There are large support measures advantaging co-operation of particular project partners. Especially new programme Competence Centres launched by the TA CR focuses on a long-term partnership of research organisations and business sector. Also large R&D infrastructures should foster science-industry links.
6	One of the most important routes, building the research capability has been a long term policy goal.	Especially, utilisation of OP RDI represents significant bulk of money that could enhance R&D performed in the Czech public sector. The projects of new research capacities have been currently realised, thus their real impact is not evident yet.

Source: ERAWATCH country reports (2010 and 2011).

4.2 Evolution and analysis of the policy mixes

The main body responsible for the formulation and coordination of the Czech RDI policy is the CRDI. At the implementation level, two ministries are the main institutions responsible for RDI issues: the MEYS (mainly academic research) and the Ministry MIT (industrial research and innovation). These two ministries are not the only institutions dealing with RDI issues. There are also other ministries with their own RDI budget, but their influence on overall RDI policies is rather minor. Their number has been reduced to five plus the two mentioned above with the implementation of the ongoing reform of the RDI system. All the ministries with RDI budget have also some conceptual documents dealing with RDI policy in their respective sectors.

In recent years, the government has started being much more active in promoting and supporting cooperation of private and public bodies in R&D. The current set of measures puts greater emphasis on technology transfer and co-operation between research institutes and private companies at the first place. In other words, the effort is to gain a more intensive inclusion of the private sector into joint public-private research projects. This shift is connected also with a

sounder support to R&D in businesses and private enterprises. These measures are to increase the private expenditures on RDI and facilitate diffusion of new technologies in enterprises.

The support programmes are either financed from the Operational Programme Enterprise and Innovation (the sub-programmes called Innovation, Potential, Cooperation and ICT and Strategic Services), or programmes funded mainly from the national sources and administered by the Ministry of Industry and Trade (IMPULS, TANDEM and TIP). All of the programmes are focused on support of industrial R&D and collaboration of enterprises with research institutions. Programmes administered by the Technology Agency of the CR (Alpha, Centres of Competence) also emphasize strengthening collaboration between public research institutes and private sector as one of their main goals. Also, the Ministry of Education, Youth and Sports currently carrying out a project called EF-TRANS; its goal is to set up and bring into effect knowledge transfer between R&D institutions and industry. A simple system of knowledge transfer is being created, with a special emphasis on patent and licenses applications, intellectual property, establishment of spin-offs, and active cooperation between research institutions and industry.

In recent years, new measures were introduced, which are visibly shifting to make public support bound to the collaboration with industry and use of research results. This trend has been evident since the National RDI Policy was approved in 2009, where one of the objectives was to condition public support through the R&D programmes by collaboration of public research organisations with users of R&D, based on co-financing from public and private sources. Some new programmes go even further, requiring an application of R&D results in practice. The latter is the case of programmes designed and implemented by the TA CR, which supports applied research, collaboration between research and application sphere and transfer of knowledge. The "new wave" of R&D programmes introduced by the TA CR in operation since 2011 or 2012 includes:

1. The programme called ALPHA - supporting projects of applied research and experimental development and stimulating intensity and effectiveness of R&D cooperation between businesses and research organisations.
2. The BETA programme - a programme of public procurement in research, experimental development and innovation for the needs of public administration bodies.
3. The OMEGA programme supporting research in applied social sciences.
4. Competence Centres supporting creation and operation of research, development and innovation centres for progressive fields with strong application potential and a perspective for significant contributions to the growth of the competitiveness of the Czech Republic.

The programme TIP administered by the MIT supports applied industrial research and R&D collaboration of the business and academic sectors. A set of new instruments within OP EI has been introduced with a support from the EU structural funds 2007-2013. These programmes are launched and managed by the CzechInvest agency. This set of programmes is designed to address needs of industrial enterprises from start-ups to mature supporting their development and R&D. Most relevantly, the Potential programme supporting the creation of R&D capacities in enterprises and formalised alliances between companies is aimed at increasing the competitiveness of business. Another relevant programme called Cooperation supports technology platforms and clusters.

The RDI policy does not stand alone, thus other policies touching directly or indirectly the issue should be mentioned. Human resources policies with relevance for R&D are currently represented within the educational policy. These measures focus on increasing the attractiveness

of research careers and research as such. Apart from several smaller local initiatives, the most prominent among these is the Česká hlava (Czech Head) project which awards an annual prize to distinguished Czech scientists for their life-long achievement. Recently this award was also extended to include awards for talented secondary school students.

In addition, two-year projects supported by the EU structural funds entitled Otevrená veda (Open Science) and Otevrená veda regionum (Open Science for Regions) were launched by the Czech Academy of Science in 2005 and 2007 respectively. The former project was prolongued for period 2009-2012 as Otevrena veda II. Both projects target primarily secondary school teachers and their students and aim to assist teachers in directing students to research careers and making the curricula of secondary school science more attractive.

More activities aimed at increasing the attractiveness of research careers and popularising research are planned in some of the OPs relevant to research ("soft" measures, such as science and technology popularisation courses under OP EC and "hard" measures, such as development of science learning centres under OP RDI). A new measure called NÁVRAT (RETURN) aimed to improve conditions for re-integration of top researchers coming back from abroad was launched under the MEYS in 2011 and the first projects have been supported in 2012. The MOBILITY programme is focused on outwards mobility of researchers supporting short-term internships at foreign partner institutions. Bilateral mobility of students and university teachers and researchers is funded by the MEYS and financial resources from Structural Funds. The Czech Republic also has access to the Fulbright Fellowship Program, which supports studying, teaching and researching in the United States.

Since 2005 the Czech government has also adopted a number of strategic documents which aim to facilitate the integration of immigrants. Although the proposed measures are general immigration measures, they may have a positive effect on the immigration of foreign R&D workers. At the end of 2007 the Czech Parliament started the debate over the amendment of Czech Immigration Act as a reaction to the EU legislation (transposition of EC Directive 2005/71 on a specific procedure for admitting third-country nationals for the purposes of scientific research). As a result, an amended law was passed before the end of 2007 which allows a specific regime (lower administrative burden and shorter procedures) for legal stay of researchers of foreign origin. This law only applies to foreign nationals employed at universities and public research organizations. Inward flows of researchers are supported also by the EURAXESS network (a part of the European Services Network / EURAXESS) funded by the MEYS, which provides information support to incoming researchers, advice and assistance on visa procedure, social security, taxes and other practical aspects of everyday life. MEYS also runs a grant programme intended for talented Master and PhD students coming from third countries and studying in public universities.

Also the involvement of the the Ministry of Finance has to be mentioned as tax incentives to deduct expenditures on R&D carried out in-house were introduced in 2005. An extension of the current tax incentives scheme for R&D is expected in the near future, when research purchased from research organisations will be also deductible from the tax base. According to the Ministry of Finance, the effect on private R&D investment is quite substantial, at least in terms of creating an incentive for businesses to report their actual R&D expenditure. The practical implementation of this fiscal measure is, however, complicated by confusion over the practical interpretation of the regulation.

The existing methodological guideline from the MF is criticised by businesses since it leaves scope for different interpretation as to what should and what should not be included in the R&D expenditure. The complaints from the business sector are addressed mainly to the lack of

awareness at the level of local tax offices who often apply an unnecessarily strict interpretation of the regulation. Anecdotal evidence from individual businesses suggests that this administrative hurdle (repeated controls from local tax offices) could de-motivate firms from applying the tax deduction in the future. It has been recognized, furthermore, that the current form of tax deduction is going against the need to intensify collaboration between the business sector academia. Hence, expenditure on external R&D services (contract research) is also going to become the subject to this exemption in near future.

Commercialisation of R&D results and transformation of new knowledge into innovation is hindered by insufficient utilisation of instruments for IPR protection. However, this situation has been changing through the implementation of the National RDI Policy 2009-2015. Together with the establishment of the TA CR implementing support for applied research greater emphasis is put on the programmes supporting innovation activities and cooperation of the academia and industry.

Attention to fostering science-industry links is paid also in several operational programmes. This concerns mainly the OP EI and its priority 4 - Innovation and priority 5 - Environment of Entrepreneurship and Innovation. The OP RDI also includes several research-innovations and academia-industry links support measures. These include mainly support of commercialisation of R&D outputs in research institutions, in particular by financing the stage from R&D information up to the stage of the subsequent commercial use (proof of concept stage) and support of the commercialisation system and intellectual ownership protection, including the establishment and development of technology transfer offices by research organisations.

4.3 Assessment of the policy mix

The main innovation policy targets as announced in the key policy documents (National Reform Programme, Reform of the Czech RDI system and the National RDI Policy 2009–2015) are consistent with the current needs for improvement of the national innovation system. However, the present RDI system can be assessed as inadequate in terms of effectiveness, flexibility and appropriateness of research and innovation governance, which results inter alia in the insufficient quality of R&D results and the detachment of public research from industrial and societal needs. The main reason lies in the remaining fragmentation of RDI governance in the Czech Republic. Creation of one central coordination body responsible for research, development and innovation is among activities of the Reform of the RDI System and of the national RDI policy, but the implementation of this task remains to be a challenge.

The reason for production of R&D results of a doubtful quality relies in the insufficient support for the excellent research and low evaluation standards. Higher efficiency of the public support system achieved also through more effective evaluation of R&D is one of the main goals of the RDI policy. However, evaluation methodology remains the challenge for the policy makers as stated in the International Audit of Czech RDI. More generally, evaluation is rather underestimated issue in the Czech Republic. Present "evaluations" of research programmes are highly formalised (including only quantitative formulation of the results achieved) and they do not provide any additional information for policy makers. Similarly, assessment of R&D programmes regarding development of relevant science fields or industry sectors or grasping societal needs cannot be achieved within the present framework. Also systematic evaluation of research organisations is missing in the Czech Republic. According to the RDI policy, a new methodology for the evaluation of research results should be elaborated taking into account

some new components (e.g. training of graduates, dissemination of R&D results, technology transfers etc.) and not only research outputs as it is the case now.

Nonetheless, some shortcomings in the RDI system have been addressed in the current in-depth Reform of the Czech RDI system. Particularly the establishment of TA CR and reduction of budgetary chapters has contributed to the improved coordination of targeted R&D funding and de-fragmentation of R&D public support. Some of the existing RDI programmes have encouraging effects on innovation activities in the business sector. More intensive inclusion of the private sector in joint public-private research projects seems to be promising as new R&D programmes have been introduced by the TA CR, but evidence on the effectiveness of the new programmes is not available yet. Generally speaking, the current innovation policy mix is largely addressing the identified challenges, but the outcomes are yet to be seen.

Challenges	Policy measures/actions	Assessment in terms of appropriateness, efficiency and effectiveness
Inefficient use of public funds for supporting R&D and innovation	New methodology for evaluation R&D results and R&D organisations	To tackle this problem, it is necessary to introduce of a complex methodology for evaluation of R&D results; the current one based predominantly on quantitative indicators has been identified as unsatisfactory; the necessity to update the evaluation methodology has been emphasized in the International Audit of Czech R&D; however, the revision requires consensus of the key players in the national R&D system, which proved extremely difficult.
Lack of external financial resources for innovation	OP EI Planned establishment of the pre-seed fund	(TA CR has been established in 2009 as the dominant supporter of applied research and launched a portfolio of new programmes; two programmes of the OP EI, Progress and Guarantee, help start-ups and micro enterprises to overcome the limited availability of external funding; however, availability of venture capital remains one of the lowest among EU27 countries; the MIT announced plans to establish a public seed fund to boost the access to venture capital.
Lack of cooperation between research and business sector	OP RDI Alpha, TIP, Competence Centres OP EI	(OP RDI supports building of the infrastructure for excellent fundamental and applied research and infrastructure for transfer of R&D knowledge; clustering activities are supported through the OP EI; there are new national R&D programmes that motivate enterprises to cooperate with research organisations in common projects; however, results of these programmes have not materialized in more intensive cooperation so far.
Protection of intellectual property rights (IPRs) is underutilized and hence market for technology underdeveloped	Realisation of the Reform Alpha, Competence Centres OP EI	Among the top objectives of the Reform of the RDI System is to improve the commercialization of R&D outputs on the market for technology and innovation processes at large; new R&D support programmes, such as Alpha and Competence Centres launched by TA CR, require the utilization of R&D results and motivate the participants to acquire IPRs; the sub-programme of the OP EI called Innovation enables beneficiaries to use the grant on IPRs; however, the number of international patents per capita remains low.
Future funding of new large R&D infrastructures	OP RDI	Six major infrastructural projects are under construction with the support from the OP RDI. After five years, their operating expenses must be covered from other sources. Private funding is likely to cover only a small fraction. Unless the government significantly expands the amount of public R&D support, there could be painful tradeoffs at stake. Either the new projects or the existing infrastructure might need to shrink. It is not clear how this situation is going to be resolved.

5 NATIONAL POLICY AND THE EUROPEAN PERSPECTIVE

Overall, despite the problems cited above, the policy mix is on the right track, aiming at the main challenges. The RDI reform has stimulated much needed public debate on the role of research for competitiveness and the development of the society at large. A number of strategic documents have been published in recent years that for the first time outlined the RDI policy in a coherent, compact and comprehensive manner. As the result, the key stakeholders become increasingly aware of the challenges and there seems to be slowly emerging consensus on the way forward. Nevertheless, in many respects the progress has been slow and if the problems are not successfully tackled in near future the goals underlying the reform are not likely to be achieved.

Governance coordination issues, the revision of evaluation methodology and more effective allocation of public institutional funding are the top priorities. The CRDI that has assumed a central role in the new governance system needs to be provided with resources that allow it to live up to this task. The GA CR and TA CR that has become responsible for competitive funding should be further strengthened to mitigate the fragmentation of support programs and overlaps in measures striving to attain the same target. The priorities of oriented RDI that have been revised provide more specific guidelines for thematic funding than used to be the case, as the results of which the volume of funding targeted on the specific themes is expected to gradually grow.

One aim that has been repeatedly stressed in the recent policy documents is promoting excellence in research. But this has been grossly mismanaged by the formula-based system of evaluation that annually reallocates the entire flow of institutional funding based solely on historical output scores. In line with the recommendations by Arnold (2011), a project launched under the auspice of MEYS is preparing a new more complex evaluation methodology of research institutions and allocation of public institutional funding; however, the results remain to be seen. Another closely related challenge that is looming on the horizon is to secure funding for operation of the newly constructed large R&D infrastructure projects, which is likely to send ripples throughout the public research sector. Overall, the public R&D funding needs to increase in order to reach the national target of 1% of GDP in Europe 2020 initiative.

Despite a number of newly introduced measures designed to strengthen the public-private interface, the commercialization of publicly funded research into innovative solutions in the business sector remains a constant challenge. MIT (2011a,b) dealing with this issue explicitly mentions the need to stimulate the so far very limited demand for innovation in the domestic business sector. The strategy proposes support for development of relevant business innovation services and suggests a long list of concrete actions, including the establishment of a pre-seed fund, knowledge transfer partnership programme, support for technology transfer services, public R&D procurement, amendment of the tax law and support for regional innovation; some of which have already started to be implemented. Nevertheless, the support is fragmented, scattered in a number of small programs. IPRs continue to be grossly underused. Admittedly, there is an urgent need for a comprehensive national knowledge transfer policy, including a new legislation on technology transfer, which tackles this challenge in a systematic way.

Another major policy shift that needs to be applauded has been from a system traditionally based on direct public subsidies to RDI in the business sector towards introducing much wider portfolio of measures aimed at alleviating the problem of insufficient availability of funding for private R&D efforts; many of which target the type of applicants, such as small and new firms,

that typically do not use the direct grants. The indirect fiscal support through R&D tax credits, which has gradually expanded in recent years, is planned to be further extended to purchase of external research services, hence this is also going to stimulate the public-private linkages. Access to venture capital that is well-known to be particularly problematic is planned to be addressed by the establishment of a public seed fund, which is expected to start operation sometimes soon. Several regions have implemented innovation voucher programmes, albeit the resources devoted to this instrument have been very small so far. More measures that go beyond the direct subsidies are clearly desirable in the future.

Labour market for researchers continues to suffer from a lack of experts. Human resources management practices in the public sector need to be revised in order to reduce the widespread in-breeding, make career progression paths more transparent and intensify competition for posts. Arnold (2011) points to the fact that less than 10% of researchers are foreign and half of those are Slovaks, which is very small proportion by international standards. There is a considerable scope for making better use of research internationalization in the public sector, the limited extend of which is in a sharp contrast to the pivotal role of foreign affiliates in the business sector. An explicit internationalization strategy of the public research system is lacking.

Generally speaking, the national policy mix is aligned with the main ERA's objectives, however, at the same time it should be clear from the analysis above that is some areas the progress falls short of expectations. Much attention has been recently devoted in the RDI reform agenda to making the national research system more effective and leaving the dysfunctional mechanism for allocating institutional funding, which is currently under revision, aside, a noticeable progress has been made in streamlining the funding system, increasing the share of public funding allocated on a competitive basis and pinpointing sensible priorities of oriented research that are largely in line with the grand challenges. Several large R&D infrastructural projects, including pan-European infrastructures, are under construction, which have a potential to both open new avenues for internationally co-operation and make the system more competitive. Nevertheless, a lot remains to be done in improving labour market for researchers and in fostering gender equality in research, particularly as far as limited mobility, internationalization, early career opportunities and rigid recruitment practices are concerned. Needles to say, major challenges remain to be tackled in the domain of circulation, access and transfer of scientific knowledge, which has been historically weak aspect of the system, and which hinders public-private collaboration.

Assessment of the national policies/measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

ERA dimension	Main challenges at national level	Recent policy changes
Labour Market for Researchers	Labour market for researchers still suffers from lack of researchers mainly in the S&T fields. International mobility is considered as one of the main challenges for improvement. low attractiveness of a research career in the CR for foreigners due to lower salaries of researchers in comparison with the EU-15 countries .	• Issue reflected in National RDI Policy and in the Reform as a high priority. • OP Education for Competitiveness and OP Human Resources and Employment support measures. • New schemes supporting inward as well as outward (short-term) mobility of researchers.
Cross-border cooperation	Low awareness of researchers about the international research programmes leading to a low participation of Czech teams in the international activities in the field of research.	• Issue addressed in the national RDI policy as a priority. • FP7 Cooperation – international teams common projects. • Czech participation in Eureka, COST etc.
World class research infrastructures	There is a number of projects supporting the development of research infrastructures from the EU Structural Funds, but there is a question remaining on the sufficient number of researchers for these new infrastructures.	• Approval of the Roadmap for Large Research, Development and Innovation Infrastructures in the Czech Republic by the Government in March 2010 • OP RDI Priority Axis 1 + 2: support to centres of excellence and regional R&D centres.
Research institutions	ASCR and universities are quite autonomous. Third role of universities shall be supported by the reform of tertiary education. There is low participation of stakeholders (mainly from industry) in university management boards.	• Institutes of the ASCR have become autonomous / independent public research institutions including their financial responsibility. • The methodology of HEIs and PROs evaluation and the system of institutional funding based on the evaluation has been deemed unsatisfactory and is under a revision.

ERA dimension	Main challenges at national level	Recent policy changes
Public-private partnerships	Several R&D programmes supporting research-industry collaboration has been launched but there is a lack of organisations ensuring technology & knowledge transfer into practice. Insufficient supply of mediation services provided to innovative companies and unfavourable conditions for setting up academic spin-offs. Low support to private-public mobility of researchers.	• Issue addressed in the national RDI policy as a priority • New programmes of TA CR (Alpha, Centres of Competence) and the Ministry of Industry and Trade (ITP) supporting co-operation between PROs and private sector • OP RDI Priority Axis 3 aiming at support of the commercialisation of research results including the technology transfer offices.
Knowledge circulation across Europe	National and European funding enabled the development of science parks, incubators, TTOs, but also qualified human resources for the technology transfer are still a challenge to support the knowledge circulation across Europe.	• MEYS is supporting the return of Czech researchers after experience from abroad through a programme called NAVRAT.
International Cooperation	Concerning the international cooperation, FPs are the most significant programmes. The participation of Czech industry in FP7 is relatively high, but the Czech universities lag behind the EU average. Participation in COST, EUREKA, CERN and other international programmes is not very well monitored.	• New measures supporting international co-operation in applied research • Support programmes of bilateral international R&D cooperation, such as KONTAKT, GESHER and MOBILITY.

Source: ERAWATCH country report (2012).

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LIST OF ABBREVIATIONS

ASCR	Academy of Sciences of the Czech Republic
BERD	Business Expenditure on Research and Development
CERN	European Organisation for Nuclear Research
COST	European Cooperation in Science and Technology
CR	Czech Republic
CRDI	Council for Research, Development and Innovation
CZK	Czech koruna
ELI	Extreme Light Infrastructure
ERA	European Research Area
ERDF	European Regional Development Fund
ESF	European Social Fund
ESFRI	European Strategy Forum on Research Infrastructures
ESO	European Southern Observatory
EU	European Union
EU27	European Union including 27 Member States
FP	European Framework Programme for Research and Technology Development
FP7	7th Framework Programme
GA CR	Grant Agency of the Czech Republic = Czech Science Foundation
GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
HEI	Higher education institutions
ICT	Information and Communication Technologies
IPR	Intellectual Property Rights
MEYS	Ministry of Education, Youth and Sports of the Czech Republic
MIT	Ministry of Industry and Trade of the Czech Republic
NABS	Nomenclature for the Analysis and Comparison of Scientific Programmes and Budgets
NIS	National Innovation Strategy
OP	Operational Programme
OP EI	Operational Programme Enterprise and Innovation
OP RDI	Operational Programme Research and Development for Innovation
PROs	Public Research Organisations
R&D	Research and development
RDI	Research, Development and Innovation
RIS3	Research and Innovation Strategy on Smart Specialisation
S&T	Science and Technology
TA CR	Technology Agency of the Czech Republic

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Abstract

This analytical country report is one of a series of annual ERAWATCH reports produced for EU Member States and Countries Associated to the Seventh Framework Programme for Research of the European Union (FP7). The main objective of the ERAWATCH Annual Country Reports is to characterise and assess the performance of national research systems and related policies in a structured manner that is comparable across countries.

The Country Report 2012 builds on and updates the 2011 edition. The report identifies the structural challenges of the national research and innovation system and assesses the match between the national priorities and the structural challenges, highlighting the latest developments, their dynamics and impact in the overall national context. They further analyse and assess the ability of the policy mix in place to consistently and efficiently tackle these challenges. These reports were originally produced in December 2012, focusing on policy developments over the previous twelve months.

The reports were produced by independent experts under direct contract with IPTS. The analytical framework and the structure of the reports have been developed by the Institute for Prospective Technological Studies of the Joint Research Centre (JRC-IPTS) and Directorate General for Research and Innovation with contributions from external experts.

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As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

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Key policy areas include: environment and climate change; energy and transport; agriculture and food security; health and consumer protection; information society and digital agenda; safety and security including nuclear; all supported through a cross-cutting and multi-disciplinary approach.

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